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Cover

Flashy Takeoff—Comstar-2 was launched by an Atlas Centaur 40 vehicle in late July. The communications spacecraft, leased from Comsat by the American Telephone and Telegraph Company as part of a nationwide communications network, is operating from synchronous orbit at an altitude of 36,000 kilometers.

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Correction—In the August issue of NASA *Activities*, a photo of Associate Administrator for Center Operations, E. S. Groo with Henry F. Auter (page 17, right-hand column) was incorrectly captioned. Mr. Auter is at left, Mr. Groo at right.

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Letter from Washington

Dear Colleagues:

Fletcher

On Aug. 1, NASA completed its historic year-long Satellite Instructional Television Experiment with India. Using the ATS-6 satellite with Indian-developed receiving sets, the experiment brought educational programming in four languages to millions of viewers in 5,000 Indian villages. This experiment is one of NASA's many pioneering efforts to engage advanced and developing nations in a space cooperation program of very real mutual benefit.

Now, as ATS-6 returns to the Western hemisphere, NASA is using it to assist the U.S. Agency for International Development (AID) in a project to demonstrate direct broadcasting to public officials, scientists, educators, and other decision-makers in two dozen developing countries.

As part of this demonstration, NASA has prepared films on three areas of technological development which have special promise for people in the developing nations: (1) advances in communications and education technology, (2) Landsat and remote sensing, and (3) space age technologies of special use for disaster prediction, assessment and relief.

NASA personnel, with NASA-developed equipment, are traveling to countries in Asia, the Middle East, Africa, and Latin America to assist AID in demonstrating the capabilities of ATS-6 and in showing the international community some of our most important recent advances in space technology.

Communications satellites are only one of the many tools being developed by NASA "for the benefit of all." Wind and solar energy, pollution control, health and safety, natural resources, transportation and industrial productivity are other areas in which NASA research and technology can, as Secretary of State Kissinger noted recently in Nairobi, "draw the fullest measure from the finite resources of our globe."

During the coming years, NASA will continue to play an active role in developing new systems that will help the world's people reach their full potential. We are particularly pleased to be in partnership with AID in examining and meeting these needs.

Sincerely,

James C. Fletcher

Monthly NASA Highlights

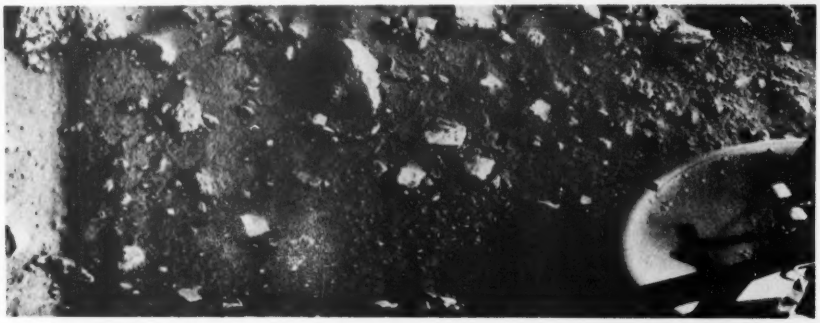
Viking 1 Lands on Mars

The Viking lander successfully touched down on the Martian surface at 8:12:07 EDT, July 20. It landed in an area characterized as a rock-strewn level region. The rocks seen in the first picture near the lander did not appear to be larger than six inches across. Larger rocks were seen in the distance, but their exact sizes could not immediately be determined.

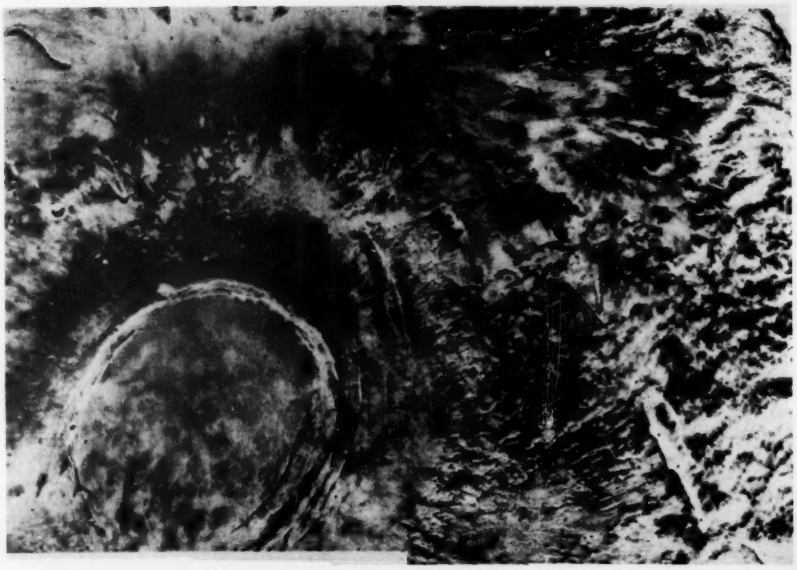
The first color picture, transmitted on July 21, showed Mars with a blue sky and a reddish, desert-like landscape. Color correction procedures showed that the sky was in fact slightly on the pink side rather than the blue familiar to Earth dwellers, which was shown in the first color picture.

The soil sampler problem aboard Viking 1 was solved when a new series of commands was sent from Earth to Mars, in which the arm was ordered to extend an additional foot to release the pin. The lander's computer and a photograph from one of its cameras showed the small latch pin to be on the rocky soil, thus verifying that the procedure was successful.

Martian soil samples acquired by the surface sampler were delivered to the Viking biology instrument where the samples in turn were distributed to three experiments for incubation and additional processing. Each of the three experiments is based on a different fundamental assumption about the possible biological requirements of Martian organisms. In combination, they constitute a broad range of ideas on how to search for life on Mars.



First "Footstep" on Mars—The Viking 1 lander sent back this picture of its metal foot on the Martian surface a few minutes after the vehicle came to rest. Finely ground material, including sand thrown up on the footpad at touchdown, is visible in the photo, along with angular-faceted rocks of varying sizes. The large rock in the center is thought to be about four inches across.



Viking Orbiter at Work Above Mars—While the Viking lander continues its analysis of the Martian environment at the planet's surface, the Viking orbiter continues to take pictures. This montage of four photos, taken July 29 by the orbiter's TV cameras from about 6,600 kilometers (4,100 miles) shows one of the enormous volcanoes in the Tharsis region near the equator. The crater is 100 km. (62 mi.) in diameter. The mountain is 27 km. (17 mi.) high, three times higher than Earth's highest mountain, Mauna Loa. Lava flows are visible on the flank of the mountain.

Comstar Satellite in Orbit

Comstar D-2, the second in a series of Comsat domestic communications satellites, was launched by an Atlas-Centaur launch vehicle from Cape Canaveral on July 22. Comstar satellites operate from geosynchronous orbit at an altitude of 36,000 kilometers (22,300 miles).

The launch support for the mission was provided by NASA on a fully reimbursable basis to Comsat General Corp., a subsidiary of the Communications Satellite Corporation.

The spacecraft will be leased by the American Telephone and Telegraph Co. as part of a nationwide communications network. Three Comstars are planned for the system, each with a capacity for more than 14,000 two-way, high-quality voice circuits. When operational, they will be capable of providing reliable communications to the 48 contiguous states, Alaska, Hawaii and Puerto Rico. The first spacecraft in the system, Comstar 1A, was successfully launched by NASA, May 13, 1976. The third is scheduled for launch in 1978 and a fourth will serve as a ground spare.

NASA's Lewis Research Center has management responsibility for the Atlas-Centaur development and operation, and the Kennedy center is responsible for vehicle checkout and launch operations.

Award Won by Gowers

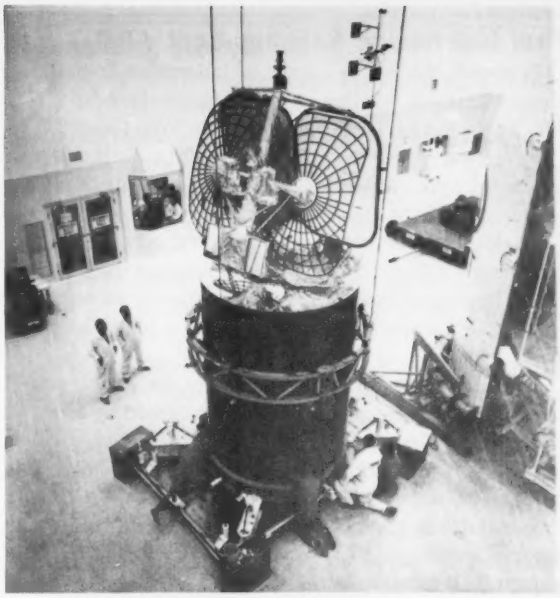
The recently initiated Spanish-Speaking Program Achievement Award was conferred on NASA's Carmen Gower for her work in developing a weekly roundup of job opportunities in the D.C. metropolitan area for use of Spanish-speaking organizations and others. Gowers was one of four recipients of the award, given by the CSC Spanish-Speaking Program Office at a recent conference in Washington.

Gowers is the Spanish-speaking program coordinator at headquarters. As such she is an active participant in many recruitment and information disseminating projects.

The award is in the form of a marble paperweight engraved with the Spanish-Speaking program logo and the inscription *"Honor a quien honor merece"* (Honor to he/she who merits honor).

ATS-6 Demonstrations Planned

A team of NASA personnel began visiting some 27 countries in August, to set up equipment that demonstrates the capabilities of the Applications Technology Satellite. A joint program with the Agency for International Development, the demonstrations are designed to bring space-age technology to developing countries in southeast Asia, the Middle East, Africa and South America. The program is scheduled for conclusion in November.



Comstar-2 Pre-launch Inspection—The latest communications satellite launched by NASA from Cape Canaveral for Comsat General Corporation undergoes final preparations at the KSC spacecraft checkout facility. Soon afterward, the spacecraft was moved to Complex 36 and mated with its Atlas Centaur launch vehicle. Launch took place without incident on July 22.

NASA Day at Kennedy Space Center

July 22 also marked the celebration of NASA day at KSC. The event was part of the Bicentennial Exposition on Science and Technology being celebrated this year at the Kennedy center.

NASA's Administrator Dr. James C. Fletcher briefed a group of dignitaries and invited guests on the status of NASA programs, including the Space Shuttle and the Viking lander. Astronaut Paul Weitz provided a report on the Space Shuttle program and Kennedy director Lee R. Sherer briefed about 120 guests on the Comstar-B launch, which they witnessed. Space lectures and demonstrations were offered throughout the day in the theater dome.

Accompanying Dr. Fletcher were representatives of eight European embassies, including four ambassadors. Olin E. Teague, Chairman of the House of Representatives Science and Technology Committee, was present, as were other members of Congress. Most of the other guests were representatives of industrial and labor organizations associated with the aerospace industry.

First Indonesian Satellite Sent Aloft

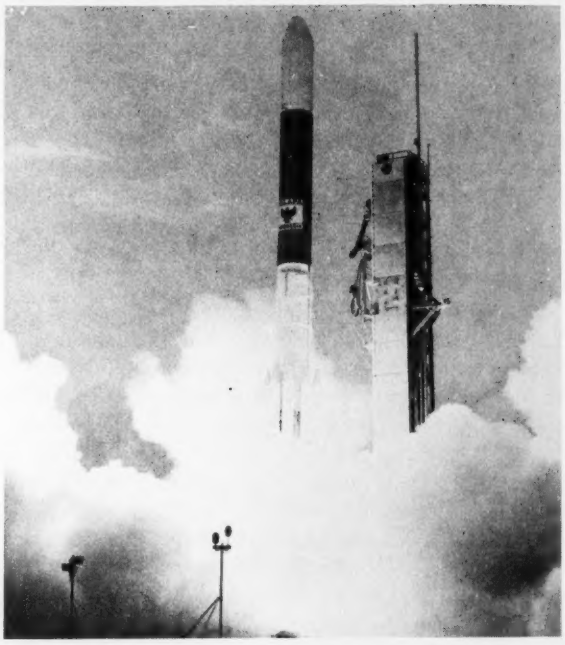
Palapa-A, the first in a series of Indonesian domestic communications satellites, was successfully launched July 8 by a NASA Delta launch vehicle from Cape Canaveral, using Kennedy Space Center facilities. NASA will be fully reimbursed for the cost of hardware, launch services, and Department of Defense range support.

Satellite communications are expected to be a boon to Indonesia's 120 million people (representing the world's fourth largest national population) scattered throughout some 5,000 islands spread across 3,300 miles of the South Pacific.

The launch occurred only hours after the first reports were received assessing the destruction caused by an earthquake in Indonesia. The earthquake took place on June 26, but poor communications prevented reliable reports until much later—on the day of the launch.

Spacecraft communications systems were scheduled to become operational to coincide with a nationwide address by the President of Indonesia on the country's independence day, Aug. 17.

The name of the satellite is in honor of Gaja Mada, a 14th century prime minister, who vowed never to eat the popular delicacy, palapa (a fruit), until Indonesia was united. The timetable for the launch and subsequent events was set to ensure that the satellite would be operational when Indonesia celebrated its 31st anniversary of independence.



Symbolizing Indonesian Unity—Palapa-A, the Indonesian communications satellite that was launched by NASA last July, began operating on Aug. 17, marking the 31st anniversary of the country's independence. The spacecraft serves to unite the inhabitants of thousands of islands by telephone, radio, television, telex and data communications.

Roy Wilkins Receives NASA Memento—Marking the retirement of Roy Wilkins, NASA's Herbert J. Rowe (right) presents the famed civil rights leader with a framed space composite, which included a mission flag from Apollo 16. The occasion was the 67th annual convention of the National Association for the Advancement of Colored People, held in Memphis, Tenn.

Civil Rights Leader Gets NASA Keepsake

Roy Wilkins, retiring executive director of the National Association for the Advancement of Colored People, recently was presented with a space memento from NASA at the NAACP's annual convention in Memphis.

Presenting the plaque was NASA's Associate Administrator for External Affairs Herbert J. Rowe. Included was a photo of the ultraviolet lunar camera and its inventor, Dr. George R. Carruthers of the Naval Research Laboratory in Washington, D.C. He is the black scientist who led the team that developed the UV camera, the world's first lunar observatory.

Rowe told Wilkins, the dean of civil rights leaders, that future flights of the Space Shuttle would carry a flight crew that reflects U.S. population percentages. Rowe added that with other Americans, instead of saying goodbye to Wilkins, he would say "Thanks for a job well done."

Weather Satellite Launched

A perfect launch sent ITOS-H into orbit at 1:07 p.m. July 29. The seventh ITOS operational weather satellite to be launched by NASA for the National Oceanic and Atmospheric Administration, the spacecraft became NOAA-5 once orbit was confirmed.

A NASA Delta launch vehicle lifted the 340-kilogram (749-pound) satellite into a 1,450 kilometer (790-mile) circular polar orbit with a period of 115 minutes. The Western Test Range was the launch site.

Instruments aboard the satellite will provide visible and infrared images of cloud cover, snow, ice, and the sea surface, and collect information on temperatures and moisture in the atmosphere.

NOAA will reimburse NASA for the launch vehicle and for launch costs.

Inside Job—The electronic components contained inside the box-like framework of the RCA-built NOAA-5 are wired by RCA technician Charles Addis. The spacecraft will beam temperature measurements and cloud cover views to satellite ground stations throughout the world. NOAA-5 was designed and built by RCA Astro-Electronics Division at Princeton, N.J., under the technical direction of NASA's Goddard Space Flight Center.

Project management and technical direction of the Delta vehicle were carried out by the Goddard Space Flight Center; launch operations were the responsibility of the Kennedy Space Center's Expendable Vehicles Directorate, Western Launch Operations Division at Lompoc, Calif. ■■■■■

Sounding Rocket Fails

The launch of a four-stage Javelin sounding rocket from Wallops Flight Center on July 17 failed to produce the red, white and blue chemical clouds that would have measured winds and magnetic and electric fields in space. The flight was terminated shortly after launch because of a mechanical anomaly.

The research rocket landed in the Atlantic Ocean before releasing the chemicals that would have created a colorful display visible along most of the East Coast and as far west as Ohio.

An investigating committee has been appointed to review the radar and telemetry data.

Poised for Flight—The four-stage Javelin sounding rocket ready for launch from the Wallops Flight Center. Malfunction after launch on July 17 caused termination of the flight before clouds of red lithium and blue-and-white barium could be released.

Congressman Hails NASA Employees

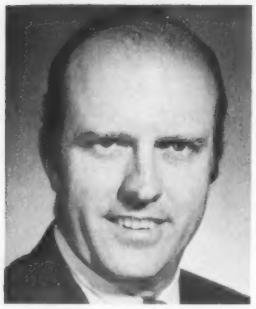
The *Congressional Record* recently reprinted remarks made on the floor of the House of Representatives by California Congressman Burt L. Talcott. Talcott, who is Minority Whip as well as the ranking Republican on the House Appropriations Committee, said in part:

"Having taken to task those who have been less than productive, let me take a moment to praise the two agencies . . . which have earned special commendation because of their particular contributions to productivity within the country. The first, and most spectacular, has been NASA, which has just celebrated the 15th anniversary of America's first manned space flight.

"In those short years since Al Shepard flew America's first suborbital flight, we have escaped the Earth, flown to the Moon and returned in safety, learned to live and work in the weightlessness of space, developed monumental amounts of new knowledge benefiting all mankind, and are well on our way to inaugurating man's first real space transportation system which will make space flight routine.

"All of these accomplishments were made within the short span of a decade and a half. Such progress would have been impossible without the special dedication of each and every NASA employee. NASA's performance over the years should serve as a guide for other agencies."

New Public Affairs Chief



Newman

Robert A. Newman became NASA's Assistant Administrator for Public Affairs in late July. Before joining the agency, he was vice president in charge of community affairs for TRW, Inc., and president of the TRW Foundation, at Cleveland.

In his new post, Newman reports to the Associate Administrator for External Affairs as the official responsible for all NASA information services except technical publications.

Born in Childress, Texas, Newman received a bachelor's degree in journalism and a bachelor's degree in sociology from the University of Missouri, and did graduate work at Bradley University at Illinois. He served in the U.S. Air Force during the Korean War. He was graduated from the Armed Forces Language School as a specialist in the Russian language and in Russian studies.

Newman's career includes marketing and corporate relations, public relations and advertising with the Caterpillar Tractor Company, Brunswick Corp., General Electric Co. and TRW, Inc.

Scientific Teams Named for Unmanned Moon Flight

A team of distinguished scientists has been selected by NASA to study and develop experiments for a proposed unmanned lunar mission to take place in 1980. The mission, under study at NASA's Jet Propulsion Laboratory, would be the first U.S. lunar mission since Apollo 17 in 1972.

It would be carried out with a low-cost, instrumented polar-orbiting spacecraft and a small companion subsatellite launched together by a single Delta vehicle.

Plans call for the spacecraft to orbit the Moon for one year, examining nearly the entire lunar surface with a battery of scientific instruments. Scientists expect to be able to measure the Moon's gravity, magnetism and heat flow, and to determine the chemical and mineral composition of the surface on the basis of the data obtained.

Surveying the Moon from pole to pole on near and far sides would add data on the entire surface, greatly increasing the earlier information collected in small areas by U.S. and Soviet missions. The contemplated mission will be the first global survey of a planet other than Earth.

Among the questions scientists hope to answer—in whole or in part—are:

- Did the Earth and Moon form from a common "reservoir" of original material?
- Does the Moon have an iron-rich core like Earth's? If so, when did it form? How did its formation affect the Moon? If it is not present, what is the source of the magnetism found in lunar rocks?
- Does evidence exist pointing to large-scale movements of material in the Moon's interior similar to those on Earth?
- What was the nature of the intense meteorite bombardment that altered the surface of the Moon early in its history?
- Have the cold, permanently shadowed polar regions of the Moon trapped volatiles—particularly water—that might be used as resources to help support a lunar base?

The eight experiment areas selected for study are highly complementary and interdependent. Three would use advanced remote sensing techniques based on gamma ray, X-ray and reflection spectroscopy to create chemical maps of the lunar surface. A fourth experiment, spectro-stereo imaging, would provide photographic data to match the chemical maps with individual features of the landscape. The magnetometer and electron reflection experiments would map the electrical and magnetic properties of the lunar surface and subsurface. The remaining two experiments, on heat flow and gravity field, would provide information on the deep interior of the Moon. Combining all these data would help scientists to understand the entire body of the Moon.

The principal scientific investigators named by NASA's Office of Space Science and their fields of interest are: Dr. James R. Arnold, University of California at Berkeley, electron reflection; Dr. Thomas B. McCord, Massachusetts Institute of Technology, infrared spectrometry; Dr. Duane O. Muhleman, California Institute of Technology, microwave radiometry; Dr. Roger J. Phillips, Jet Propulsion Laboratory, gravity and altimetry; Dr. Christopher T. Russell, University of California at Los Angeles, magnetometry; and Dr. Jacob I. Trombka, NASA Goddard Space Flight Center, X-ray spectrometry.

Each of the eight principal science investigators named by NASA will be accompanied by groups of co-investigators. The 71-member science team will be aided by JPL staff members. Study scientist at JPL is Dr. T. V. Johnson.

Spotlighting Humanity's Future

One of the highly worthwhile fringe benefits NASA offers its personnel is the opportunity—several times a year—to attend a presentation of expert views on a variety of issues related to the world's changing technological, social, economic and political environment.

The program, called "Profiles of the Future—the Administrator's Colloquium Series," began in 1973 at the earlier suggestion of Dr. Wernher von Braun, who left NASA in 1972. The concept for the series was developed by Arthur D. Reetz, Jr., deputy program manager of Mariner programs (Colloquium Series chairman); and Nathaniel B. Cohen, director of the office of policy analysis (Colloquium Series consultant). To date, 13 leading authorities on as many different subjects have shared their knowledge with NASA employees.

The well-received program so far has featured individuals who are particularly qualified to discuss the world around us in terms of what the future may hold and probable directions of change. Topics have covered a wide range of interests, including: economics, the environment and populations, the individual, industry, information technology and physical medicine.

The speakers have been prominent representatives of colleges and universities, private academic institutions, the political arena and the field of journalism.

The most recent speaker at the Colloquium Series (Aug. 4) was Dr. Carl E. Sagan, well-known both in and outside NASA as a brilliant interpreter of NASA's Viking mission during the past year. Director of Cornell University's Laboratory for Planetary Studies and a member of the Viking lander imaging and site selection teams, Sagan is one of the world's foremost spokesmen for planetary science. His subject at the recent colloquium was "The Chance of Life Elsewhere."

The speaker at the next Colloquium, to take place Nov. 16 in the FOB-6 headquarters auditorium, will be Dr. Bernard B. Davis, professor of bacterial physiology at the Harvard Medical School. His subject will be "Genetic Engineering—Threat or Promise."

All future speakers will be chosen in an effort to continue the delineation of various aspects of the social, economic, political and scientific environment in which NASA functions, and to encourage an awareness of critical issues on the part of NASA personnel.

New identifying artwork (see accompanying photograph) to symbolize the Administrator's Colloquium Series was designed recently by Dale Eno, an artist in NASA's Graphics and Management Presentations Division at headquarters.

Administrator Visits Yugoslavia

President Ford sent Dr. James C. Fletcher to Yugoslavia in July as a U.S. representative to attend ceremonies honoring the memory of the Yugoslavian-American physicist Nikola Tesla, who would have been 120 years old on July 7. Tesla's work in electricity is renowned; he was the inventor of the Tesla coil and induction motor.

Space Suits to Be Manufactured

The Hamilton Standard Division of United Technologies, Inc., of Windsor Locks, Conn., has been selected by NASA for negotiations leading to the award of a contract for the development and production of space suits to be used by men and women during Space Shuttle flights.

The contractor's proposed cost of the basic cost-plus-award fee contract is about $15 million through September 1980.

The suit will provide Space Shuttle crew members with protection and life support while they work outside the Shuttle in Earth orbit. An "adjustable fit" will be a feature of the suits compared to earlier versions that were custom-made for individual astronauts.

To be manufactured in small, medium and large sizes, the suits will fit candidates from 152 centimeters (five feet) to 193 cm. (five feet four), the range of heights listed recently in a NASA announcement for Shuttle candidates.

The suit system consists of a basic suit and a support system that includes breathing atmosphere and cooling components. The life support backpack is an integral part of the suit. (See NASA *Activities* for May 1976.)

Technical direction of the contract is by the Johnson Space Center.

Veteran Trainee Program a Success

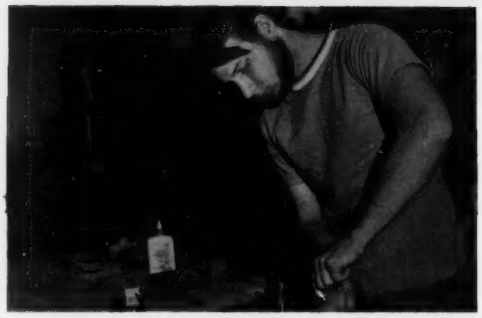
A group of returned veterans who are participating in the Veteran/Worker-Trainee Program at the Goddard Space Flight Center are performing most satisfactorily, Goddard officials say.

Seven veterans, all but one a minority worker, have been hired since last December and placed in wage-board jobs that pay $3.63 an hour to start as a WG-1, and up to $4.05 an hour as a WG-3. Ultimately they can work up to a WG-10, which pays $6.44 to $7.52 per hour.

Jacques Knox, chief of plant operations, who supervises four of the workers, says they are "dedicated and eager to learn. They seem to be very much interested in acquiring a trade." Another supervisor of two of the vets, Winslow Womack (chief of the quality assurance division) says: "They are doing very well. In fact, one of them, because of previous experience that didn't come through in his original application, has been much more of a satisfactory addition to our organization than we ever expected."

Under Civil Service regulations issued in late 1975, recently discharged veterans may receive special two-year appointments and are entitled to all regular Federal employee benefits including promotion. Eligibility requirements for the jobs are that the potential employee be a veteran released from the armed forces within the preceding year or released from hospitalization or treatment immediately after separation from the armed forces.

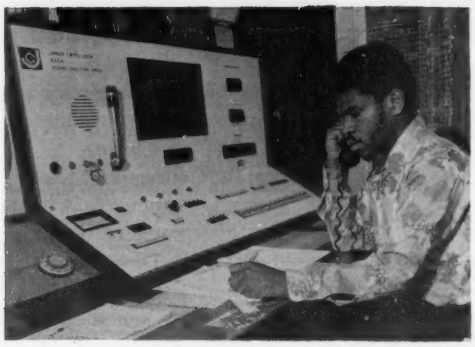
To be hired, the veteran must have had no more than 14 years of education, must have served in the military after Aug. 5, 1964, and must agree in writing to pursue the training program.



Alan Wilkerson is a wood craftsman trainee. At present he is building a cabinet to be installed in the Goddard visitor center. Wilkerson says, "I like the job. I've been doing shop work, anything that can be built or repaired. When I finish my training here, I will be a journeyman carpenter."

Edward Tolson is assisting in the installation of high-voltage underground cable. Tolson says, "It's a very helpful program to a veteran who has just got out of the Army. I'm very happy to get this chance, especially at a time when jobs were hard to find."

John Blanks, a quality engineering trainee, is assisting in the preparation of the configuration baseline of the Goddard-designed IUE components. He will use this configuration baseline to verify the status of the components before they are integrated into the spacecraft. He says: "I like the job. It's different and offers a lot of challenge including decision-making. For example, whether or not to accept a contractor's proposal for parts or specifications or to accept components for the spacecraft can depend on decisions made."



William Brumby operates the central utility control console. The computer-controlled system operates and monitors all Goddard center utility systems. When he is finished, Brumby says, he will be an operational engineer, which means he will be an expert in maintaining refrigeration and heating equipment. "I identify problems, run equipment such as the 75-ton chiller, which has to do with air conditioning and heating," he says, adding "I like this kind of work and think it is really good training for us veterans."

Viking Receives Presidential Acclaim

Despite the fact that Dr. James C. Fletcher sent a congratulatory statement to all NASA employees, including the text of President Ford's Proclamation, NASA Activities wishes further to commemorate Viking's stunning achievements by reproducing the Administrator's special announcement of July 20.

"I hope that you will share with me the pride that I experience in reading the attached proclamation from President Gerald R. Ford. In declaring July 20, 1976, Space Exploration Day, the President has in effect commended all of you who work under the collective roof of the national space agency.

"We are now deep into the Viking mission and yet all of our tomorrows reflect the remarkable accomplishments of the past. This is the essence of President Ford's declaration. We have done things undreamed of by generations still on Earth; we will surpass even these in the future. (signed) James C. Fletcher, Administrator."

"THE WHITE HOUSE
SPACE EXPLORATION DAY, 1976

BY THE PRESIDENT OF THE UNITED STATES OF AMERICA

A PROCLAMATION

In the last two decades of our Nation's second century, we entered upon the exploration of yet another frontier—the corridors of space. Seven years ago, on July 20, 1969, this great national effort culminated in a transmission to Earth from a quarter million miles distance—"the Eagle has landed."

The world watched in awe as an American took his historic one small step onto the Moon. A dream of thousands of years had been realized. In keeping with tradition, the American presence in that new land was symbolized by the planting of the Stars and Stripes, which proclaimed the benefits of human freedom for the entire universe.

The space programs reflect not only technological skill of the highest order, they reflect the best in the American character—sacrifice, ingenuity and our unrelenting spirit of adventure. We begin our third century with a further expression of that combination, the brilliant unmanned mission to Mars, the most ambitious of all deep space explorations.

In celebrating the Bicentennial, we have gloried as a people in the history of a great and successful venture in the human experience. We gave thanks for our blessings and offered prayers for the future. It is appropriate that we again call upon Divine Providence for guidance and protection in our quest of space and those endless horizons in all the centuries to come.

As we once set about to conquer the wilderness and settle our continent, now we set out upon a journey into the unknown of our universe. Wherever we reach, we will have come in peace for all mankind.

NOW, THEREFORE, I GERALD R. FORD, President of the United States of America, do hereby proclaim Tuesday, July 20, 1976, as Space Exploration Day. I urge all Americans, and interested groups and organizations to observe this day with appropriate ceremonies and activities.

IN WITNESS WHEREOF, I have hereunto set my hand this nineteenth day of July, in the year of our Lord nineteen hundred seventy-six, and of the Independence of the United States of America the two hundred first. (signed) Gerald R. Ford."

PROSPECTUS

Unmanned Satellites as Part of the Space Program

By 1960, to NASA personnel it had become simply "The Cape." Just a few years before, the stretch of coastline in northeast Florida on which Cape Canaveral and the Kennedy Space Center are situated was wild terrain, blanketed by palm, palmetto and marshland. Its principal denizens were snakes and alligators. When the national space agency came into existence in 1958, the Army Corps or Engineers had already moved into the area and had begun construction of a large complex from which to launch Saturn vehicles. NASA completed the task and built a second adjoining facility.

Cape Canaveral was coming to life.

The primary mission, mandated by the Space Act, was to take the rocket plane program and developments in rocketry and raise them to the ultimate degree. Man was to cast off the bonds of Earth, reach the atmosphere of space and return safely. To add impetus, NASA knew that the Soviet Union was busily engaged in the same endeavor.

Before risking human life in space, however, a long series of unmanned launches had to be executed from the Cape. An Army Redstone placed the first U.S. spacecraft, Explorer I, into low Earth orbit to measure the radiation belt. The Explorer was followed by a series of other projects, progressing through Scout, Atlas, Thor Agena, Delta, Titan and Saturn. Space vehicles blew up on the pad and fell into the ocean.

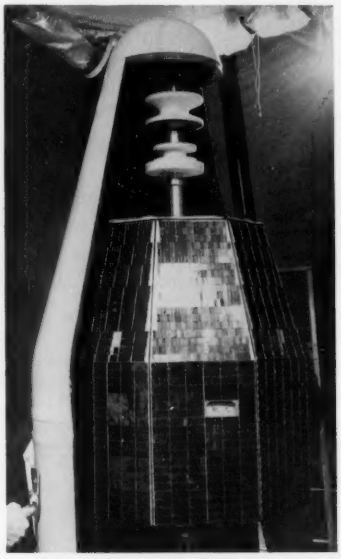
The "bugs" were plentiful and elusive. But the men and women of this young science persisted and the launch systems began to pay off. Orbital launch capability increased from Explorer's 25 pounds to Saturn's 250,000 pounds. Swiftly, in day-by-day operations, the U.S. space program matured, refined its techniques, and confirmed and expanded the theories of Robert H. Goddard.

Twenty days after the first American had reached space, President Kennedy charged the Congress and the citizens of the United States to undertake an all-out effort that would land an American manned spacecraft on the Moon before the end of the 1960s. World attention swung to Cape Canaveral. The astronauts and their vehicles—Freedom 7, Gemini III ("The Unsinkable Molly Brown")—became household names. And people, caught up in a human drama, lost much of their interest in what Atlas Agena and Delta were doing.

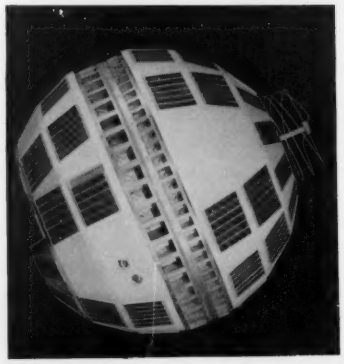
Throughout the manned space flight missions, with all their attendant publicity, the Kennedy Space Center also was enlarging its role as the primary launch site for unmanned satellites. The massive press and television coverage given every astronaut blastoff but served to obscure the continuous launching of unmanned spacecraft designed to benefit Earth.

Yet, in the 1960s and 70s, the workhorses of space were quietly assuming a stature of vital importance to the world.

The era of communications satellites opened with Relay and Telstar. Almost overnight, the work of ground stations, land lines and submarine cables were rendered nearly obsolete. The first satellites, operating in low Earth orbit, offered the equivalent of 15 simultaneous telephone lines. Today, performing in synchronous orbit, the communications workhorses provide the equivalent of 15,000 lines. The monthly charge for a telephone circuit between the East Coast and Europe was $10,000; it is now under half that amount. The first one-hour television program linking Europe and North America cost $22,350. The rate is now $5,000.



Continental Link—The Relay-1 satellite, launched in late 1962, is mated to the third stage of the Delta launch vehicle. The spacecraft was boosted into an elliptical orbit altitude of 800 to 4,500 miles. The first Project Relay experimental communications satellite, it linked three continents—North America, Europe and South America.



An Era Begins—The first communications satellite to be built and owned by a private company, Telstar -1, was launched in 1962. The 77-kilogram (170-pound) spacecraft was also the first one to transmit television pictures and sound.

The Applications Satellite, perhaps more than any other space innovation, has served to bring the people of the world together. The powerful ATS-6, launched from the Kennedy Space Center in July of 1974, has beamed educational programs and medical help to hospitals and clinics from Appalachia to Alaska and, now, India.

The weather satellites sent up from KSC began immediately to improve the accuracy of forecasting and to give timely warning of dangerous, potentially devastating, storms which once struck with little if any notice.

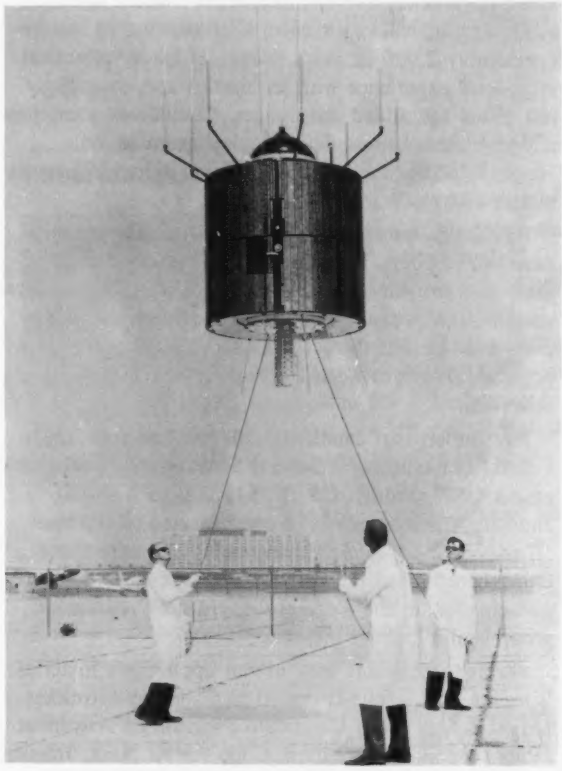
In little more than a decade, governments and individuals have come to listen to voices which for years echoed in the wilderness. Realization that the resources of Earth are finite has brought intense demands for action; NASA has answered with the earth resources satellite, Landsat. Today, scanning the Earth every 18 days, the Landsat records the unique signatures radiated by vegetation and the land it grows on, water and minerals, and even the impact of man-made structures. For agriculture, the potential is enormous. Crop management by satellite tells the farmer more than he learns by physically walking across his own fields. The Landsat can single out a specific region and sort crops in a matter of hours, relaying the information to high-speed computers.

The computer system itself, both on the ground and in spacecraft, has advanced in giant strides to meet the wave of information from space. The storage of information in flight today provides for later, more advantageous retrieval. Although storage systems for flight have to date relied on magnetic tape, drums and discs, developments such as the multi-track, long-duration tape recorders have increased man's ability to store and access from a 15-page pamphlet to a 2,000 book library.

Day-by-day, out of sight and out of the public consciousness, the workhorses tell Earth of the dangers of disease and insects affecting forests and crops; they report the breakup of ice in lakes and navigable waters; from orbit, they inform the crews of ships and aircraft of their precise positions; they even tell fishing fleets where the biggest schools can be found.

At the Cape today, foreign accents are almost as prevalent as American. The satellite programs have become truly international enterprises, with NASA, on a reimbursable basis providing the launch vehicle, and other governments supplying the payload. Developed nations in particular use our facilities to place communications satellites in orbit— several of the 19 launches this year, for example, are for that purpose. Even Indonesia, a poor nation with little industry, yet with the world's fourth largest population, joined the exclusive circle of domestic communications satellites owners last July.

Twelve times the Earth trembled at the Cape, spectators watched in awe amid flame and dense fumes as Saturn rose from Merritt Island. But those great moments alone did not establish the Kennedy Space Center as historic ground. The years of experimentation, the constant launching of invaluable unmanned satellites, the increased international involvement contributed in large measure to the center's fame. Today, this NASA facility is, and will continue to be, the premier spaceport of the world.



Early Applications Technology Satellite—Antenna pattern testing was conducted by engineers rotating a flight model of ATS, satellite (3) launched from Cape Kennedy in late 1967. The satellite, suspended from a crane, was rotated to simulate the way it would spin in space. The ATS carried a payload of experiments into synchronous orbit 22,300 miles above the South American continent.

Call for Astronauts Is Issued

Fifteen pilot candidates and 15 mission specialist candidates will be selected during the next year and a half, for duty on the Space Shuttle. Application details were published by NASA in recent months. Applications will be accepted until June 30, 1977 and all applicants will be informed of selection or rejection by December 1977. Candidates will be chosen without reference to sex or race, in accordance with NASA's affirmative action program.

Those selected will report to the Johnson Space Center on July 1, 1978, for two years of training and evaluation. Final selection as an astronaut will depend on satisfactory performance by the candidates during the evaluation period.

Pilot applicants must have earned a bachelor's degree from an accredited institution in engineering, physical science or mathematics or must have completed all requirements for a degree by Dec. 31, 1977. An advanced degree or equivalent experience would be an advantage, as would a record of at least 1,000 hours (preferably 2,000 or more hours) of leader-pilot time. High-level experience with jet aircraft and/or as flight test pilots are added advantages. Candidates must pass a NASA Class I space flight physical examination. Height of applications can range from 163 to 193 centimeters (64 to 76 inches).

Applicants for mission specialist candidate positions need not be pilots. Educational qualifications are the same as those for pilot applicants except that biological science degrees are included. Mission specialist applicants must be able to pass a NASA Class II space flight physical. Height between 152 and 193 cm. (60-76 in.) is desired.

Pay for civilian candidates will be based on the Federal Government's General Schedule pay scale from grades GS-7 through GS-15, $11,000 to $34,000 annually. Candidates will be compensated on the basis of individual academic achievements and experience. Other benefits include vacation and sick leave, and participation in the Federal Government retirement, group health and life insurance plans.

Civilian applicants may obtain application material from the JSC. Requests should be mailed to Astronaut (Mission Specialist) Candidate Program or Astronaut (Pilot) Candidate program, Code AHX, Nasa, Johnson Space Center, Houston, Texas 77058.

Military personnel should apply through their respective military departments, using procedures which will be outlined later this year by the Department of Defense. Military candidates will be detailed to JSC but will remain on active military status for pay, benefits, leave and other military matters.

At present, 31 persons are available as Space Shuttle crewmen, including nine scientists. Twenty-eight of them are astronauts assigned to the Johnson center and three hold government positions in Washington, D.C.

The Space Shuttle is a reusable vehicle that will replace virtually all of this nation's space launch vehicles. Shuttle missions could include deploying and retrieving satellites, servicing spacecraft in orbit, operation laboratories for astronomy, Earth Sciences, space processing and manufacturing, and developing and servicing a permanent space station.

Launched like a rocket, the Shuttle will perform Earth orbital missions of up to 30 days, then land like an airplane and be refurbished for another mission. Pilot astronauts will control the Shuttle during launch, orbital maneuvers and landings, and be responsible for maintaining vehicle systems. Mission specialist astronauts will be responsible for the coordination of overall orbiter operations in the areas of flight planning, consumables usage and other activities affecting payload operations. At the discretion of the payload sponsor, the mission specialist may assist in the management of payload operations and may, in specific cases, serve as the payload specialist. They will be able to continue in their chosen fields of research and to propose, develop and conduct experiments.

Crews may consist of as many as seven people—commander, pilot, mission specialist and up to four payload specialists, who need not be NASA employees and who will be nominated by the sponsors of the payload being flown. Payload specialists will at times operate specific payload equipment.

Potential users of the Space Shuttle include government agencies and private industry from the United States and abroad.

Hansing Retires

Dr. Frank D. Hansing, Director of the Office of University Affairs retired from NASA effective Aug. 14, after completing 31 years of Federal service. He was with NASA from 1962 on, first as chief in the Training Division of the Office of Grants and Research Contracts, then as director of the Sustaining University Program in University Affairs, finally as director of that unit.

On retiring from government service, Hansing accepted a position with the National Academy of Science as Associate Director of Fellowships in the Commission on Human Resources.

Did You Know?

World interest in the Viking landings, directed from the Jet Propulsion Laboratory, was intense throughout the many weeks of activities that began in July. Some 300 news correspondents were registered to cover the mission for more than 100 publications. Television and radio reporters were on hand from all major networks in the United States, and television crews from Hungary, Great Britain, Italy, Belgium, France, West Germany and the Netherlands photographed events at JPL.

Daily attendance at the KSC Bicentennial Exposition has been running between 5,000 and 6,000 in recent weeks, somewhat above the break-even point cited in NASA's contractual arrangements with the concessionaire serving the summer-long presentation.

The Satellite Situation Report—data compiled by the Goddard Space Flight Center, NORAD and the Smithsonian Astrophysical Observatory—puts the number of manmade objects in space orbit as of February 1976 at 3,828, and decayed objects at 4,881.

National Hispanic Week will be observed at NASA headquarters Sept. 12-18. In observance of this year's Heritage Week, NASA, in cooperation with the Health, Education and Welfare's Education Office, is planning appropriate ceremonies and activities to include prominent speakers, exhibits, films, entertainment and food. All are invited.

The Research and Engineering Corp. of Cambridge, Mass. recently was awarded a fixed-price contract for the design, fabrication, assembly, test and demonstration of a portable, self-contained fire-fighting module. The Marshall Space Flight Center granted the contract—in the amount of $209,368—for a unit called the U.S. Coast Guard Fire Fighting Module, designed to be used in fighting either shipboard or dock fires. Complete with pump, hose, fire fighters' suits and other equipment, the module will be a portable, lightweight unit that can be transported by helicopter and placed on the deck of any medium-sized craft in the vicinity of a fire. It can pump a minimum of 1,500 gallons of seawater per minute uninterruptedly for three hours.

According to a count made at the Johnson Space Center, men in space have traveled a total of 118,077,569 statute miles in the flights of Mercury, Gemini, Apollo, Skylab and ASTP.

NASA's recent supplemental agreement to the basic Shuttle Orbiter contract with Rockwell International, Space Division is in the amount of $3,676,000, covering hardware and materials for production of the orbiter. The items are: glass window panes from Corning Glass Works at Corning, N.Y.; American Enka rayon yarn and green silicon carbide from Carborundum Corp.; remote power controllers from Westinghouse; and event indicators from Weston Instruments.

The Klate Holt Co. of Houston has been awarded a one-year, $1.5 million contract extension for custodial support services at NASA's Johnson Space Center. The cost-plus-award-fee contract extends through June 30, 1977. The contractor employs approximately 160 persons who furnish custodial services in the 82 buildings at the space center and 16 buildings occupied by JSC personnel at the nearby Ellington Air Force Base. ■■■■

Important Award for NASA Woman

Hunkapiller

Barbara T. Hunkapiller, a program analyst in the plans and analysis unit of the Marshall center's computer service office, was named "Woman of the Year" by the Ala-Hunt chapter of the American Business Women's Association for achievements in business, education participation in the association and in community activities.

Hunkapiller will represent her chapter in competition for the 1976 "Top Ten" and "American Business Woman of the Year" awards at the international convention to be held in New Orleans in October. Representatives from more than 1,300 ABWA chapters will vie for the award.

ABWA is an educational association devoted to improving employee-employer relations, keeping business women up-to-date on business techniques, and the advancement of women in business through more efficient methods and services to business.

Solar Power Fuels Runabouts

Sunshine charged the batteries of two electric vehicles used during the past summer at the Festival of American Folk Life on the Mall in Washington, D.C. Solar cells, originally used to power satellites in space, were the means by which energy was provided to the two vehicles which resemble golf carts and are equipped with six standard traction batteries. One cart was used to transport workers around the Mall, the other—fitted with a vacuum cleaner—was used to pick up refuse.

The venture is the product of a cooperative effort by the Department of Interior's National Capital Park Service and the ERDA/NASA Photovoltaic Test and Demonstration Project.

NASA's Lewis Research Center, which provided the photovoltaic array, manages the project for ERDA. The array supplies about 1.7 kilowatts of electricity during peak sunlight hours. The photovoltaic cells used in the demonstration came from NASA's Jet Propulsion Laboratory, which is responsible for managing ERDA's Low Cost Silicon Solar Array Project.

The Lewis center has been experimenting with the transfer of space-related, solar-cell technology to terrestrial applications since 1971. Lewis scientists say that by the mid-1980's, solar-power systems probably will be operating in the one-to-ten megawatt range and they expect that by the year 2000, solar-cell arrays will be widely used to provide energy to homes and factories.

Look Ma, No Gas—Althea R. Washington, a NASA employee, at the wheel of one of the solar-powered carts used on the Washington, D.C. Mall during the bicentennial celebration of 1976. The standard traction batteries used on the vehicles derive power from an array of photovoltaic cells seen in the background.

International Symposium Held at Goddard

Scientists from around the world were at the Goddard Space Flight Center recently for three days, attending Goddard's second international gamma-ray astronomy symposium. The symposium was entitled "The Structure and Content of the Galaxy and Galactic Gamma Rays."

As was true of the very successful international gamma-ray symposium, the proceedings will be published as a NASA special publication and a preprint of the proceedings is available in X-document form.

Involved scientists pointed out that since the first symposium in 1973, gamma-ray astronomy has advanced significantly, largely because of Goddard's highly successful SAS-2 satellite experiment. Gamma-ray astronomy has developed from the discovery phase into the exploratory phase experimentally, and blossomed theoretically. The results from SAS-2 are becoming available in final form and the European Space Agency's COS-B satellite detector, now orbiting the Earth, is providing new data and results.

The relationship between the new observational data on gamma rays originating in our Galaxy and results from other fields of observational and theoretical galactic astronomy were emphasized during the symposium. Distinguished astrophysicists from the world scientific community presented papers relevant to understanding the nature of our Galaxy and its structure, and the particular role of gamma-ray astronomy in adding to that understanding.

Gamma-ray astronomy is unique among all the branches of observational astronomy in that it makes possible the study of the distribution of high-energy cosmic rays in the Galaxy, inasmuch as the interactions of cosmic rays with interstellar gas produce most of the gamma rays observed. Symposium participants generally agreed that a big breakthrough seems to have been made, owing to the gamma-ray results from SAS-2, which provide strong evidence that most cosmic rays that bombard the Earth originate in our own Galaxy rather than in extragalactic regions.

Among the speakers from Goddard at the symposium were David Thompson and Robert Hartman, who presented an up-to-date summary of the SAS-2 results; and Donald Kniffen and Floyd Stecker, who discussed the theoretical implications of the gamma-ray results for large-scale study of galactic structures. Carl Fichtel and Jacob Trombka took part in a panel discussion of future gamma-ray astronomy missions.

New Method for Developing Clearer Photos

A chemist at NASA's Marshall Space Flight Center has invented an improved method for intensifying the image on photographic films and plates after a picture has been developed.

Barbara S. Askins, with the Space Sciences Laboratory's astronomy branch, developed the post-process image intensification procedure under the direction of Dr. C. R. O'Dell, now the center's associate director for science.

Askins' method utilizes autoradiography to improve the images on underexposed or underdeveloped films or plates. Autoradiographic film intensification is a process by which the silver or other photograph imaging material on a developed film or plate is converted to a radioactive compound by exposing the material to a radioactive environment.

Placing the radioactivated film or plate in contact with a receiver emulsion (an unexposed film or plate) reproduces the original picture, but with increased contrast and density.

Askins said that two methods of activating the imaging silver were the subjects of experimentation. One uses a neutron activator to bombard the original film or plate with radioactive particles. The other method chemically induces radioactivity by bathing the film or plate in a radioactive isotope solution. She concentrated her entire effort on the latter, it being more practical for use in standard photo laboratories.

In the past, though autoradiography has shown great promise, its usefulness suffered because of the complicated techniques, hazardous chemicals and expensive equipment required to induce radioactivity. The chemical process developed by Askins eliminates those factors.

Another problem encountered in other chemical methods has been an inability to achieve a high "signal-to-noise" ratio, meaning that background fog tends to lessen the contrast on the photographic image. Askins said the effect is caused by the radioactive chemical acting on the gelatin in the emulsion and on the imaging silver.

By using an organo-sulphur 35 compound, Askins was able to achieve quality autoradiographs with a high degree of image intensification and a small amount of background fog. The isotopic compound she uses and the method of reaction with the photographic silver are the keys to the improved process. It eliminates certain time-consuming steps and produces better quality intensifications.

Askins said the process easily can be adapted to an ordinary photographic laboratory. The only additional equipment needed, she said, would be holding drums for the waste isotopic compound and a fume hood. Holding drums would not be necessary unless the lab used more than one curie (a unit that disintegrates at a specific rate) of the isotope per year—the amount allowed by law for dumping into regular sewage disposal systems. Only about one microcurie of radioactive material is required for each square centimeter of film to be intensified.

Askins said the initial use of the process would probably be in the area of astronomy and other scientific research in which lowlight levels are encountered, but that it has potential in many commercial usages.

A patent has been filed for the process, and if the method proves patentable over other methods, the process will be made available for commercial licensing by NASA.

BEFORE

Advance in Photo Processing—This view of the Marshall Space Flight Center taken from a tower top shows an underexposed photograph and the identical picture after image intensification by the Askins process. The remarkable improvement in clarity in the bottom picture took place after autoradiography was used on film.

AFTER

The Climate of Mars

In this, the third of six articles by Dr. Carl Sagan, the author discusses what was known about Mars' climate before the Viking lander touched down on Martian soil last July 20.

The planet Mars is very cold. Its atmosphere is very thin. In the tropics, the temperature drops by more than 80 Celsius (150 Fahrenheit) degrees every night. The coldest temperatures ever recorded anywhere on Earth in the last few thousand years are higher than average mid-latitude Maritian temperatures. At the poles, the temperatures are low enough for carbon dioxide to freeze out from the sparse polar air, and the polar caps are at least in part immense deposits of dry ice.

Spectroscopic analysis of sunlight reflected off Mars shows the presence of tiny quantities of water vapor in its atmosphere and immense quantities of water chemically bound up in the surface rocks. There are probably large amounts of water ice in the polar caps and vast quantities frozen in the subsurface as permafrost at lower latitudes.

Thus there is water vapor and water ice and chemically combined water but—except for small amounts in tiny pores in the Martian soil—there can be no liquid water on Mars today.

The reason is very simple. For a material to remain liquid it must satisfy two conditions. First, its temperature must be between its freezing point and its boiling point. Equatorial daytime conditions on Mars satisfy this condition for liquid water. But in addition there must be enough atmospheric pressure to keep the material liquid. A liquid exposed to a vacuum will evaporate very rapidly. Molecules would meet no impediment when escaping from its surface and soon the liquid will have evaporated away. There is so little atmosphere on Mars that the boiling point is very close to the freezing point and in any case evaporation will occur very rapidly. Open pools of pure liquid water, flowing rivers of water, cannot exist on Mars today.

And yet there seems to be evidence of running water on Mars. One of the most astonishing findings of the U.S. Mariner 9 mission to Mars was that the planet is covered with thousands of sinuous tributaried channels. The largest are 100 to more than 1,000 kilometers (60 to more than 600 miles) long; have tight meanders; tributaries running in the correct direction downstream; teardrop shaped islands, correctly oriented with the sharp point downstream; and with complex braided patterns of silt. The smallest ones—vastly more numerous—are only a few miles long with vague sinuosities and few tributaries.

The channels of Mars correspond neither in position nor in form to the "canals" which we now know to be due to errors of human perception in pre-spacecraft times. Some of the smaller channels may be valleys not produced by running water. Some of the larger channels—particularly those which begin in a jumbled chaotic terrain—may be produced by breakout flooding of ice-dammed subsurface water. Many of the channels seem to be produced by rainfall. No alternative liquid besides running water has been proposed which is reasonable for the physical conditions of Mars. We thus are faced with an apparent paradox: The environment of Mars does not permit running water; and yet the surface of Mars is covered with signs of running water.

Widescreen Marscape—This first panorama beamed back from the Martian surface by Viking 1 Lander covers 300 degrees around the Chryse Planitia landing site. A plateau-like prominence on the left horizon is much brighter than foreground material between rocks—some of which suggest to observers whimsical names like the Midas Muffler rock (oval rock in left foreground) and VW Beetle rock (on horizon, left center). The horizon is about three kilometers away from the Lander.

But how old are the channels? The only tool for dating them which we have at present—and it is a poor tool—is counting the number of impact craters in and around the channels. We can estimate the population of impacting debris on Mars through its history: The higher the number of impact craters the longer the channel must have been around to accumulate them. In this way it has been determined that some of the larger channels are hundreds of millions of years old. Others may be, for all we know, much older or much younger.

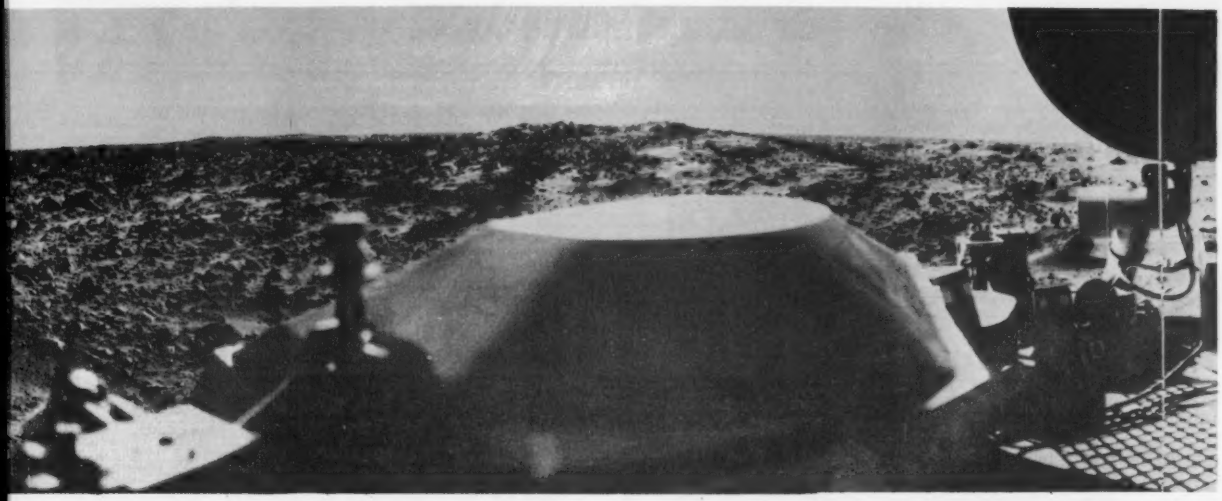
A solution to the paradox then becomes evident: The climate of Mars varies. Today Mars is plunged into deep ice-age conditions. But at least once and possibly many times in its past it has experienced higher pressures, balmier temperatures and abundant running liquid water. There are many interesting implications of this idea. If Mars can undergo such enormous climatic variations, can this shed any light on the climatic variation which the Earth has experienced? Two million years ago the site of present-day Chicago was under glaciers several miles high. Does the Martian experience provide us with some cautionary reminders about how not to change the environment of the Earth? And also there is the question of life. Do those milder early conditions suggested by the channels mean that Mars once had an environment entirely suitable for life? Could there be life on Mars today evolved from those earlier conditions and awaiting the end of the long winter?

Before these questions are addressed we must be sure that the channels were in fact carved by liquid water and that the climate of Mars is in fact variable. We need more information. There is no trouble in hiding a dense earlier atmosphere on Mars today. The enormous thickness of the polar caps corresponds to a very thick atmosphere. According to one estimate, if the polar cap were vaporized it would correspond to an atmospheric pressure over the whole planet as thick as that on Earth today. But we do not know very well the age of the various polar deposits. Crater counts by the high resolution cameras on the Viking orbiter could help resolve this issue. It may be possible for the Viking lander to check directly the idea that the channels were produced by running water—for example if the inorganic chemistry experiment detects great quantities of salts typically moved by rivers.

But Viking will perform another and in a way a much more interesting test. If in its remote past Mars had a much denser atmosphere, where could that atmosphere be today? I have already mentioned that it could be frozen away in the polar caps if the polar temperatures are below the freezing point of the atmosphere. Or it could have chemically combined with the surface of Mars if that early atmosphere underwent such chemical reactions. Or it might have all escaped to space from the top of the Martian atmosphere, if it were composed of sufficiently light gases.

Now there is one particular gas which will do none of these things. It is called argon. Its freezing point is far below the coldest temperatures on Mars. It is a so-called noble gas which does not engage in any chemical reactions of note whatever.

And it is so heavy that it could not possibly have escaped from Mars. If in its early history the gurglings and rumblings of the Martian interior outgassed a great atmosphere, many of the constituents may have been lost by one or another of these mechanisms. But not



and projections at or near the horizon may represent the rims of distance impact craters. A horizontal cloud stratum can just be discerned halfway between the horizon at the top of the panorama. Spacecraft components, from left to right, are Earth-command low-gain receiver antenna, housing for sample arm, camera calibration color charts, magnetic properties experiment mirror, and the high-gain dish antenna for direct Lander-to-Earth communications.

argon. If there was once a dense atmosphere, argon should still be present in the Martian atmosphere.* (On Earth it makes up about one percent of our atmosphere for just these reasons.)

In 1973 the Soviet Union made an unsuccessful attempt to land a Viking-class spacecraft on the surface of Mars, a spacecraft called Mars 6. It mysteriously failed within one second of landing. Among its instruments was a device called a mass spectrometer, designed to analyze the composition of the Martian atmosphere after landfall. On the way down to the surface, the mass spectrometer was busy scrubbing itself clean of residual gases leaking in from the Martian atmosphere during descent.

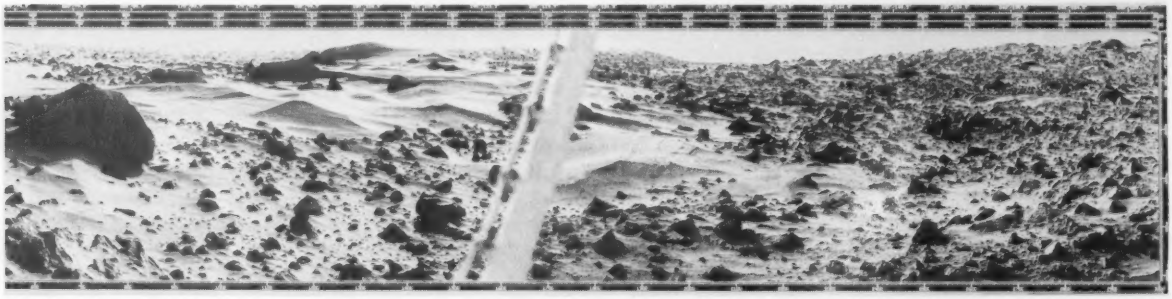
The pressure of the device was monitored. To the surprise of the Soviet investigators the scrubbing mechanism worked very poorly and a high residual pressure remained.

Now this might be caused by a malfunction such as a leak, but it would have to be a very special sort of leak. The alternative is that the Martian atmosphere contained unexpectedly large amounts of a gas immune to the scrubbing. The most likely such gas turns out to be argon. The Soviet investigators surmised that the present Martian atmosphere contains 35 percent argon with an uncertainty of about 15 percent. The remainder of the atmosphere is almost exclusively carbon dioxide.

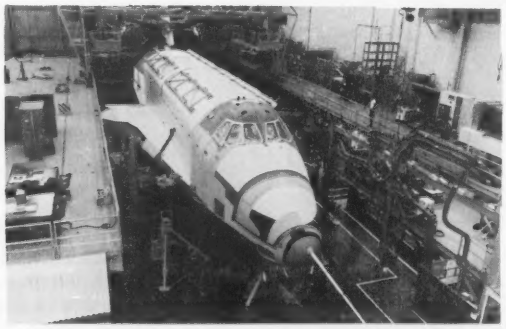
This is precisely the result we would expect if Mars had a very dense early atmosphere. But the Mars 6 measurement is indirect and has an alternative explanation. Three instruments onboard Viking, two of them mass spectrometers, will be capable of checking the argon abundance. If Viking works well we should have clear-cut evidence on the argon abundance and the past history of Martian climate.

We seem to be on the verge of being able to compare the past climatic histories of other planets with our own. In a few months we may be able to check out the tantalizing idea than in an earlier epoch in Martian history, the sky was blue, the winds were mild, the air was thick, the temperatures relatively balmy and the gurgle of streams and the mighty roar of cascading rivers could be heard abundantly on the surface of the Red Planet. And if in the past, why not in the future? Might we be able at some future time to prod Mars into returning to its pleasant past environment and—if there is no indigenous life—hosting immigrants from the distant planet Earth?

** Editor's note: Lander samples taken in late July have shown that argon is present in quantities of 1.5 percent and 2 percent in the Martian atmosphere.*



Forbidding Landscape—In another stunning shot from the Viking lander 1 on Mars, details of the terrain are revealed with complete clarity. The photo was taken early in the morning (7:30 a.m. local Mars time) of Aug. 3. The camera was looking northeast at left, southeast at right. The large boulder at left is about eight meters (25 feet) from the spacecraft and measures about one by three meters (three by ten feet). The lander's meteorology boom cuts through the middle of the picture. The sun had risen two hours earlier.



Almost Ready to Fly—The Space Shuttle Orbiter in final assembly at Rockwell International Corporation's Palmdale, Calif. facility. Rollout ceremonies are scheduled for Sept. 17. Early in 1977 the Orbiter 101 will be transported overland to NASA's Dryden Flight Research Center for approach and landing tests. First flight attached to a Boeing 747 aircraft is scheduled for March 1977; first free flight after separation from the 747 is scheduled for July 1977.

Thunder and Lightning Under Study

A Thunderstorm Research Program, history's most highly concentrated effort by meteorological scientists to increase man's knowledge of electrical charges in cumulo-nimbus clouds, lightning and thunderstorm dynamics has been underway all summer at the Kennedy Space Center. Study will be resumed next summer and in the same period in 1978.

Involved in the important program are some 70 meteorological and electronics scientists from many of the nation's leading research organizations and from several U.S. universities, as well as from the University of Manchester in England. The program came about after the Kennedy center management invited the scientific community to take advantage of spaceport facilities to study the many thunderstorms that occur over Florida during the summer. The invitation was accepted by the American Geophysical Union and the American Meteorological Society. The Naval Research Laboratory and the National Oceanic and Atmospheric Administration's Severe Storm Laboratory outlined goals and invited participation by scientists.

Experiments utilize instruments brought to KSC by participating scientists—ground systems, instrumented aircraft, and tethered and free-flying balloons to probe cloud formations. The scientists also employ many of the spaceport's instrumentation systems, including the electric field-measuring (field mill) system developed for detection of the buildup of electrical charges in thunderclouds that can interfere with space vehicle launches; NASA-6, the center's instrumented aircraft that was used in earlier lightning studies; the lightning detection and ranging system; weather radars; the storm detection meteorological radar set, including camera and digitized automatic radar tracking systems; the Cape launch pad lightning warning system; a weather information network display system; a satellite imagery acquisition system with equipment for processing weather satellite pictures; an automatic picture transmission recording system; and timing and camera systems.

NOAA's National Weather Service office at KSC and the Air Force Weather Service office at Cape Canaveral also offer assistance to the program.

The researchers are carrying out a wide variety of experiments centered on observation and study of the phenomena that cause electrical charges in cumulo-nimbus cloud formations and electrical discharges within and between clouds and to the Earth's surface. The program differs from a 1948 study of the dynamics of thunderstorms, in that it concentrates on electrical characteristics.

Participants include: NOAA, the New Mexico Institute of Mining and Technology, Rice University, the University of Florida, South Dakota School of Mines and Technology, State University of New York at Albany, University of Arizona, the Naval Research Laboratory, the University of Miami, the University of Manchester in England, the Atlantic Science Corp., the Massachusetts Institute of Technology, and NASA's Goddard and Johnson centers.

Sightseeing at the Dryden Center—Former astronaut Jack Swigert, now staff director for the House Committee on Science and Technology, was a recent visitor at the Dryden Flight Research Center. Accompanying him was Air Force Flight Test Center Commander Major General Thomas Stafford, also a former astronaut. Shown on a tour of the center are (l. to r.) DFRC deputy director Gerry Griffin, Gen. Stafford, Swigert and center director, Apollo 15 commander David Scott.

Dignitaries at Langley Dedication—Administrator Dr. James C. Fletcher (left to right) Senator Harry F. Byrd, Jr., Hampton (Va.) Mayor Ann Kilgore and Langley Research Center director Donald P. Hearth attended ceremonies in dedication of the Systems Engineering Building, the Solar Collector Array, and the Technology Utilization House.

Contract for Space Shuttle System

The Beech Aircraft Corp. of Boulder, Colo., has been awarded a $2,250 million contract by the Kennedy Space Center for development of a fuel cell servicing system for the Space Shuttle orbiter. The contract provides for the corporation to design, fabricate, test and deliver the complete cryogenic, remotely controlled unit that will provide liquid hydrogen and liquid oxygen for orbiter fuel cells. Delivery of the system to KSC is to be completed by Dec. 1, 1977.

An orbiter will receive electrical power from three fuel cells that use cryogenically stored hydrogen and oxygen. Each cell will be connected to a separate power bus. During periods of peak or average power loads, all three fuel cells will be used, but only two will be used during minimum power loads.

KSC is modifying Apollo/Saturn facilities and constructing new processing facilities for Space Shuttle operations. The first launch is scheduled for 1979.

Lunar Souvenir—The Lewis Research Center recently acquired this 175-gram Moon rock collected during the Apollo 15 mission by astronaut David Scott. Holding the four-billion year old sample is Peggy Kromer, coordinator of the Lewis Speakers' Bureau; and Ronald F. Kiessling, chief of Advanced Systems and Spacecraft Testing.

NASA Employee is Triply Honored

Waterhouse

In the space of just one week, Mae Walterhouse of the Kennedy Space Center was: accepted as a participant in the 1976-77 career development program at NASA headquarters; elected national president of Federally Employed Women, Inc.; presented with the Barbara B. Tennant award (for distinguished service to the organization) by FEW. Walterhouse is Federal Woman's Program Coordinator at KSC since March 1975. Before that she was a project management specialist. She has been with the federal government for more than 20 years, with the Kennedy center since 1964.

Walterhouse will report to headquarters Sept. 7 for one year with the Office of Resources Management.

Walterhouse has been an extremely active member of FEW since 1970 when she became a charter member of the space coast chapter. Since then she has held a number of offices at the local, regional and national level.

NASA Scientist Visits Russia

Dr. Charles T. N. Paludan, chief of Marshall's earth resources office, data systems laboratory, participated in two international conferences in Russia recently, presenting papers at each. Paludan attended in his capacity as U.S. participant in the Commission on World Land Use Survey, one of 20 research commissions associated with the International Geographical Union.

The land use conferees met in Simferopol in the Ukraine and the 23rd International Geographical Congress was held in Moscow. Paludan presented a paper entitled "Land-Use Surveys Based on Remote Sensing from High Altitudes" at the former meeting; "Satellite Image Theme-Extraction for Small-Scale Land-Use Mapping" was his subject at the latter conference in a paper jointly authored by Dr. Erno Csati of the Hungarian Institute for Surveying and Mapping.

Immense Wind Turbine to Be Built

The largest windmill in history is to be built during the next two years in a test program sponsored by the Energy Research and Development Administration and NASA. The two agencies have selected the General Electric Co., Valley Forge, Pa., and the Hamilton Standard Division of United Technology Corp., Windsor Locks, Conn., to design and build the new system.

ERDA and NASA are negotiating a contract with the industrial team for about $7 million to design, fabricate, assemble, install and test a 1.5 megawatt (1,500 kilowatt) wind turbine electrical generating system. The 20-month contract includes an option to build a second wind turbine. ("Wind turbine" is the term used for modern electrical generating windmills.) The project will be directed for ERDA by NASA's Lewis Research Center.

Although experimental in nature, the system will be located at a utility company site (to be selected by ERDA) and will supply electricity to the local electric system for use by the general public. The purpose of the test system is to determine the economics and operating characteristics of large wind turbines when coupled with conventional power plants.

The windmill will have two slender fiberglass rotor blades spanning 61 meters (200 feet), perched on a 46-meter (150-foot) tower. The windmill will rotate at 30 to 40 revolutions per minute at winds of 35 kilometers per hour (22 m.p.h.). At a site with average wind speeds of 29 km/h (18 m.p.h.), for instance, the machine could produce enough energy annually to supply more than 500 homes.

The major portion of the contract cost will cover the design and engineering. The General Electric Co. will be responsible for the overall system design and assembly; the subcontractor, Hamilton Standard, will build the rotor blades and hub. The option to build a second wind turbine is estimated at an additional $2.5 million. If these systems prove successful and can be producted in quantity in the future, cost is expected to decrease significantly.

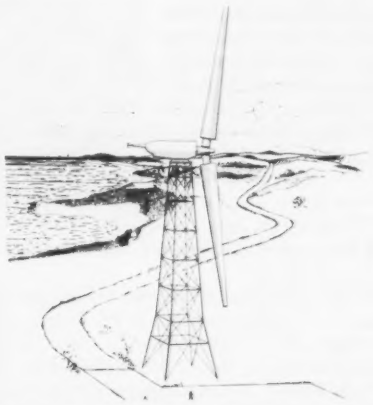
The experimental wind turbine is part of ERDA's program to develop wind energy systems and test their practicality as a potential source of energy for the nation. The Lewis center, expert in aerodynamics and structures, directs that aspect of ERDA's wind-energy program.

To identify favorable high-wind locations for the large wind turbine and two smaller ones that will be built, ERDA recently selected 17 candidate sites—proposed and named by utility companies— across the nation. Wind characteristics at the sites will be measured in the next year and final selection of the installation sites will be made during late 1976 and 1977.

The largest windmill ever built previously was the 1.25 megawatt, 53-meter (175-foot) diameter Smith-Putnam system built in the 1940s at Grandpa's Knob, Rutland, Vt. The project was abandoned as a potential source of energy because it was too expensive at the time.

The largest wind turbine presently operating is the 100-kilowatt, 38-meter (125-foot) diameter system built for ERDA by the Lewis center at its Plum Brook test area in Ohio. It is being used to identify and solve technical problems associated with large wind turbines and will be used in the future to test advanced components.

The two more powerful versions of the system to be built soon, according to ERDA and NASA plans, will be constructed at sites to be selected from among the 17 candidates recently identified. Those systems will provide information to help in the design of larger machines, and to test the usefulness of the large system. ERDA also is investigating and developing much smaller windmills that might be used to supply energy to rural homes or farms, as well as working on advanced, unconventional designs.



To Be the Largest Windmill Ever—An artist's concept of the forthcoming ERDA-NASA wind turbine, which will span 61 meters or 200 feet in diameter. The device may be able to satisfy the energy needs of 500 homes.

Large Windmill in Operation—The largest wind turbine now in operation is at Sandusky, Ohio, atop a 30-meter (100-foot) tower. The energy project is part of ERDA's wind energy program, serving to study the potential of wind as a source of energy. The Lewis center built the windmill at its Plum Brook test area for ERDA. It produces enough power for some 30 homes.

Fletcher to Welcome Conference Attendees

Administrator James C. Fletcher is planning to attend the International Conference on the Stratosphere and Related Problems, to be held at Utah State University in mid-September. He will welcome conferences at the morning session, Sept. 15.

The major international conference will feature scientific sessions on field and laboratory measurements, on chemical elements in the stratosphere, on stratospheric halogens, on the implication of regulation, and on the interactions and relations between scientists and policy makers.

NASA's Jet Propulsion Laboratory made arrangements for NASA's participation in the conference; Dr. W. T. Huntress of JPL is the executive secretary. The meeting is a major element in NASA's Upper Atmosphere Program funded in the Office of Space Science.

Lunar Sample Exhibits

The following is a schedule of lunar sample exhibits from mid-August to mid-September:

California—San Pablo Gem Festival, Pinale, Sept. 11-12.
Ohio—Children's Hospital Air Show, Columbus, Aug. 14-15; Armstrong Air and Space Museum, April 1-Sept. 1.
Texas—Houston Museum of Natural Science/History, end of Caroline at Hermann Park, Houston, Aug. 15-Sept. 15.
American Freedom Train—(Conn.) Meriden, Aug. 13-15; (N.J.) Asbury Park, Sept. 2-6, Atlantic City, Sept. 8-10, Newark, Aug. 20-23, New Brunswick, Aug. 24-26, Trenton, Aug. 30-Sept. 1; (N.Y.) White Plains, Aug. 16-19; (Penna.) Bethlehem, Aug. 27-29, Philadelphia, Sept. 11-14.
High Flight Bicentennial Mobile Space Museum—U.S. Army, Germany, Aug. 8-Sept. 4.
Tennessee Valley Association-Bicentennial Caravan—(Tenn.) Dunlap, Aug. 17; McMinnville, Aug. 18-19; Tullahoma, Aug. 20-21; Winchester, Aug. 22-23; Fayetteville, Aug. 24; Pulaski, Aug. 25-26; Lawrenceburg, Aug. 27-28; Hohenwald, Aug. 29-30; Columbia, Aug. 31-Sept. 1; Murfreesboro, Sept. 2-3; Shelbyville, Sept. 4-6; Franklin, Sept. 7; Nashville, Sept. 8-14; Lebanon, Sept. 15-16.

Long-term Displays

Alabama—Alabama Space and Rocket Center, Marshall Space Flight Center, Huntsville.
Florida—Visitor Information Center, Kennedy Space Center.
Kansas—Eisenhower Library, 200 SE 4th St., Abilene.
Mississippi—The National Space Technology Laboratories, Bay St. Louis.
New York—United Nations Building, New York City.
Ohio—USAF Museum, Wright Patterson AFB; Visitor Information Center, Lewis Research Center.
Texas—Johnson Library, University of Texas, Austin; Visitor Information Center, Johnson Space Center, Houston.
Virginia—Visitor Information Center, Langley Research Center, Hampton.
Washington, D.C.—National Geographic Museum; Smithsonian Institution, National Air and Space Museum; Washington National Cathedral.

Lovelace Visits Marshall Center—Dr. Alan M. Lovelace, recently appointed to NASA's number two spot as Deputy Administrator, toured the Marshall Space Flight Center in July. His tour of center facilities took him to the science and engineering directorate, among other units. Here J. E. Kingsbury, directorate chief (center front), discusses his program with Lovelace (left). Dr. William R. Lucas, center director (right), looks on. In the background are (l. to r.) Dr. C. A. Lundquist, director of the Marshall space sciences laboratory; Richard G. Smith, MSFC deputy director; and John S. Potate, associate director for management at MSFC.

New Chief Counsel for Dryden Center

Mathews

John Mathews was appointed chief counsel at NASA's Dryden Flight Research Center in early August. He transferred from the National Space Technology Laboratories where he was chief counsel from 1968 on. In that post, he worked closely with federal, state, university and private industrial organizations involved in space and environmental activities.

Mathews was instrumental in the development of the multiple-agency installation on the Mississippi Gulf Coast. The site became a field installation in 1974; previously, as the Mississippi Test Facility, it was the site for the static firing and flight certification of rocket boosters used in the Apollo program.

Mathews was an attorney at the Marshall Space Flight Center before going to NSTL.

He is a graduate of the University of Tennessee, where he received his Judicial Doctorate degree in 1963.

Flight Research Studies Underway

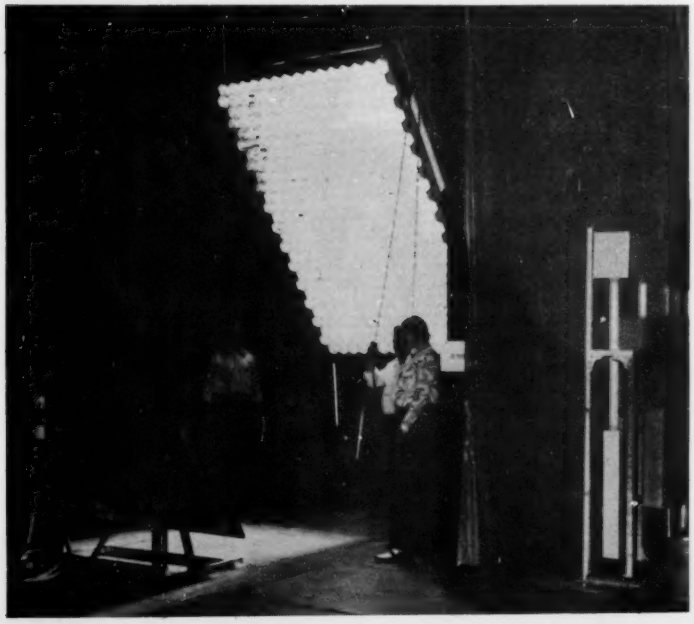
A series of flights of the YF-17 aircraft is taking place at NASA's Dryden Flight Research Center, intended to aid future designers of highly maneuverable aircraft.

The YF-17 is a twin engine aircraft incorporating many innovative concepts that help give it its high performance and maneuverability. The craft was built by the Northrop Corp. for the U.S. Air Force lightweight fighter program. The U.S. Navy F-18 fighter to be built by McDonnell Douglas and Northrup is a derivative of the YF-17.

The two prime objectives of the NASA research program centered on the YF-17 are, first, to collect data about in-flight pressure around the afterbody of the aircraft and the engine nozzles; second, to continue the flight research studies pertaining to improved maneuvering capabilities for fighter aircraft, including buffet, stability and control, acceleration capabilities and handling qualities. The in-flight pressure data will be compared with wind-tunnel predictions in an effort to improve wind-tunnel prediction techniques. Such data are important to the design of future fighter aircraft, particularly aircraft with twin-turbofan engines.

The NASA program involves flying the YF-17 for about eight weeks under a $255,000 contract funded by NASA and the U.S. Navy.

Fighter Plane with New Features—The YF-17 twin-engine aircraft is a star performer in the Air Force lightweight fighter program. The Dryden Flight Research Center carried out a program recently which collected data concerning ways in which design features might be improved.



Instant and Constant Sunshine—A solar simulator developed at NASA's Marshall Space Flight Center provides imitation sunshine day or night and in inclement weather for the testing of solar energy collectors. The lamp array consists of 405 300-watt high-intensity lamps, each with a lens that refracts the light into straight beams. Operating the test facility at Marshall are (l. to r.) Jack C. Reily, William H. Holcomb, Dr. Thomas L. McCrickard and Paul E. Cates.

Launches for 1976—Completed and Projected

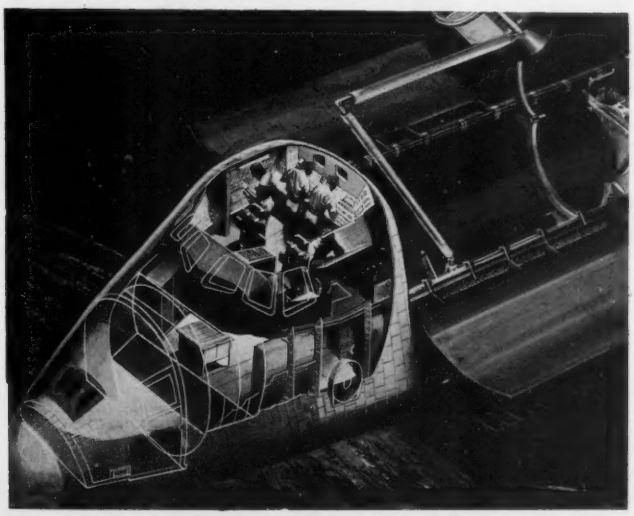
Name	Launch Date	Vehicle	Range	Mission Remarks
Helios-2	Jan. 15	Titan/Centaur	ETR	Scientific satellite to investigate the properties of interplanetary space close to the Sun. Cooperative with Germany.
CTS	Jan. 17	Delta	ETR	Experimental high-powered communications satellite. Cooperative with Canada.
Intelsat IVA-F2	Jan. 29	Atlas/Centaur	ETR	Comsat communications satellite—reimbursable.
Marisat-1	Feb. 19	Delta	ETR	Comsat maritime communications satellite—reimbursable.
RCA-B	March 26	Delta	ETR	Second RCA (Satcom) domestic communications satellite—reimbursable.
NATO-III-A	April 22	Delta	ETR	Communications satellite for the North Atlantic Treaty Organization—reimbursable.
Lageos-1	May 4	Delta	WTR	To demonstrate space techniques that will contribute to the development and validation of predictive models for earthquake hazard alleviation, ocean surface conditions and ocean circulation.
Comstar-1	May 13	Atlas/Centaur	ETR	Domestic communications satellite for Comsat—reimbursable.
Air Force Test	May 22	Scout	WTR	USAF scientific payload—reimbursable.
Marisat-B	June 9	Delta	ETR	Second Comsat satellite to provide maritime satellite communications--reimbursable.
Relativity	June 17	Scout	Wallops	Scientific probe to test the Einstein Theory.
Indonesia-A (Palapa)	July 8	Delta	ETR	Indonesian communications satellite 1—reimbursable.
Comstar-2	July 22	Atlas/Centaur	ETR	Second domestic communications satellite for Comsat—reimbursable.
NOAA-5	July 29	Delta	WTR	Operational meteorological satellite of the National Oceanic and Atmospheric Administration to provide day and night cloud cover imagery—reimbursable.
Navy Transit	Aug. 11	Scout	WTR	Navy navigation satellite—reimbursable.
RCA-C	October	Delta	ETR	Third domestic communications satellite for RCA—reimbursable.
Marisat-C	December	Delta	ETR	Third Comsat satellite to provide maritime satellite communications service—reimbursable.
Intelsat-IVA-C	December	Atlas/Centaur	ETR	Third of a series of improved Intelsat satellites—reimbursable.

Space Suit Attracts Attention—A group of teachers participating in an aerospace education workshop sponsored by Memphis State University recently visited the Marshall center for briefings on programs and a tour of the facilities. Here several of the women inspect the liquid-cooled garment worn on Apollo space flights. Glenn Dobbs of Marshall's test laboratory wears the suit.

Patents for Inventions from NASA Research

The Office of General Counsel, NASA Headquarters, announces that the following U.S. patents have been issued by the U.S. Patent Office to NASA for inventions resulting from NASA research. Inquiries concerning them should be directed to the attention of the NASA Patent Counsel for the indicated installation.

Inventor(s) and Employer(s)	Title and NASA Docket	Patent No.	Installation
Walter H. Higa, Caltech/JPL	Stirling Cycle Engine and	3,971,230	NRLO
Herbert A. Zook, NASA/JSC Richard W. High, NASA/JSC	Meteoroid Capture Cell Construction	3,971,256	JSC
Jack M. Pope, NASA/ARC Thomas B. Fryer, NASA/ARC	Miniature Ingestible Telemeter Devices to Measure Deep-Body Temperature	3,971,362	ARC
Cyrl Feldstein, Gilbert W. Lewis, Robert H. Silver, Virgil H. Culler,	Myocardium Wall Thickness Transducer and Measuring Method Caltech, JPL	3,971,363	NRLO
Cyril Feldstein, Gilbert W. Lewis, Robert H. Silver, Virgil H. Culler,	Catheter Tip Force Transducer for Cardiovascular Research Caltech, JPL	3,971,364	NRLO
Robert T. Jones, NASA/ARC	Oblique-Wing Supersonic Aircraft	3,971,534	ARC
William J. Anderson, NASA/LeRC	Thrust Bearing	3,971,602	LeRC
John Houseman, Caltech/JPL	Hydrogen-Rich Gas Generator	3,971,847	NRLO
Michael W. Fitzmaurice, NASA/GSFC James B. Abshire, NASA/GSFC.	Polarization Compensator for Optical Communications	3,971,930	GSFC
Ronald E. Sheets, Tamarack Scientific Co., Inc., Orange, Calif.	Detector Absorptivity Measuring Method and Apparatus	3,971,940	LaRC
Eph Konigsbert, Konigsbert Instruments, Inc., Pasadena, Calif.	Accelerometer Telemetry System	3,971,940	ARC
James W. Blue, NASA/LeRC	Proluction of 1231	3,971,697	LaRC
Grace L. Picciolo, NASA/GSFC Emmett W. Chappelle, NASA/GSFC	Method of Detecting and Counting Bacteria	3,971,703	GSFC
Arthur L. Schmitt, NASA/JSC Anne Flippin, Kentron Hawaii, Dallas, Texas	Sun Angle Calculator	3,971,715	JSC
Melvin M. Saffren, Caltech/JPL	Method and Apparatus for Generating Coherent Radiation in the Ultra-Violet Region and Above by Use of Distributed Feedback	3,972,008	NAPO
George M. Dudley, NASA/LaRC	Machine Tool Having Internally Routed Cryogenic Fluid for Cooling Interface between Cutting Edge of Tool and Workpiece	3,971,114	LaRC



Manned Space Shuttle Operations—This is an artist's depiction of how the Space Shuttle orbiter will look once emplaced in Earth orbit. The cutaway view shows orbiter crewmen at their duty stations on the flight deck. The payload bay doors are open after releasing a payload into Earth orbit.

Are you getting your **1 cent** worth from **NASA**?

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A Sterile Suit that Guards against Infection

A spinoff of the biological isolation garment worn by astronauts allows hospital patients who are highly vulnerable to infection to leave their sterile habitats for several hours, carrying their germ-free environment with them.

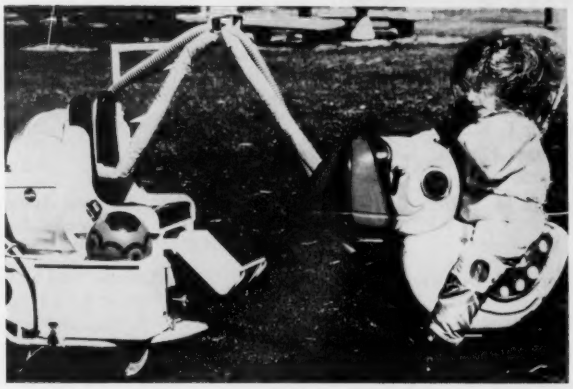
The garment was designed originally to be worn by astronauts returning to Earth until they could be placed in the quarantine facility aboard recovery ships. It provided protection of our environment against unknown microorganisms from the Moon—an unnecessary precaution as it turned out, but one that may be important to humans visiting other planets.

A prototype isolation garment has been tested in hospitals and by the National Cancer Institute with favorable results. The garment is a coverall type of suit with attached mittens and slippers, all made of a penetration-resistant, easily sterilized fabric. The fabric prevents penetration of particles greater than 0.3 microns. A separate hood with a transparent face mask is attached to the suit, and air is supplied through a flexible diffuser at the top of the hood. The filter-blower system that provides the air is powered by rechargeable batteries. Positive pressure is maintained to prevent unfiltered air from entering the unit.

Suit Maintains a Pure Environment—In a demonstration of the biological isolation garment, the young daughter of a NASA employee at the Johnson Space Center shows how the suit operates to allow sick people to leave the hospital and enjoy the outside world. The filter blower system is housed in the wheeled vehicle behind the little girl.

Researchers point out that the garments can be used in any of some 200 hospitals where isolation rooms are maintained for treatment of leukemia, radiation injuries, burns, respiratory diseases, organ-transplant patients, and immune-deficient children.

To date, the Arthur D. Little Co., Cambridge, Mass., has produced a prototype and three copies of the isolation garments, which cost $15,000 for the prototype and $8,000 apiece for the copies. Experimentation is being conducted primarily by the National Cancer Institute.



A Windfall from Space—This adaptation of a garment first worn by astronauts protects hospital patients with serious health problems who ordinarily must be kept in isolated, infection-free quarters. The biological isolation garment maintains a sterile atmosphere while a patient is away from a hospital. Victims of acute leukemia are among those who may be helped by the suit—medical authorities say that environmental infection is responsible for nearly 70 percent of deaths related to the disease.

NASA

National Aeronautics and
Space Administration

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